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THE MANGO WEEVIL.

(*Cryptorhynchus mangiferae* Fabr.)

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The destructive work of the mango weevil in the seeds of mangoes was noted in Hawaii for the first time last year. The nature of the insect and its injury point it out to all persons interested in the culture of the mango as a serious pest. In the family Curculionidae, to which this beetle belongs, occur numerous species of the most injurious character. The cotton boll-weevil has destroyed over \$50,000,000 worth of cotton in the Southern United States since its appearance in Texas in 1892. The curculios of the apple, plum, quince and strawberry do enormous damage to these and related fruits. The chestnut weevil and the acorn weevil, extending their injury to other nuts, have added greatly to the evil reputation of this family of beetles. Looking in the future to the Mainland as a market, it is readily seen that to prevent an embargo on mangoes, this enemy must be

controlled and its widespread distribution throughout the islands of the group prevented. The present limited knowledge of the mango weevil is herewith presented to aid those interested in the problem in formulating an outline of warfare.

ITS HISTORY

Mr. E. A. Schwarz, of the United States Bureau of Entomology, to whom the writer is indebted for the determination of the mango weevil, says in a letter, under date of July 26, 1905:

The weevil is *Cryptorhynchus mangiferae*, originally described by Fabricius (*Systema Entomol.*, p. 139, 1774) without locality. Since that time it has often been described and figured. I think that, after all, the best description is that by Boheman in Schoenherr's *Gen. et. Spec. Curc.*, vol. IV, pt. I, p. 91. Its original home is uncertain, for since many years it has spread (no doubt through the agency of man) throughout the "Oriental Region" from Madagascar through India, Ceylon, etc., to Java and other Malayan Islands. It probably occurs now also in many of the islands of the Pacific Ocean, although I fail to find any records. The species is not enumerated by Sharp from the Hawaiian Islands and is no doubt a recent introduction there.

The weevil appears to be extremely injurious to mangoes, and accounts of its ravages are numerous. The literature is, however, not easily accessible, the most available reports being in the "Indian Museum Notes" (at several places). A paper on the mango weevil by Mr. Simmons, read before the Calcutta Microscopical Society is referred to in *Nature*, Vol. 37, 1888, March 22, p. 492, and there seems to be a full account in a work (which I have not seen) entitled "Les insectes nuisibles au Manguier a l'ele Maurice" par D. L'Emmery de Charnoy, Paris, 1898. The oldest economic and illustrated account appears to be by Hubner in the "Naturforscher," vol. XXIV, 1789, a publication quite unknown to me. Larva and pupa are tolerably well figured in the "Indian Museum Notes."

The following is taken from an article by Mr. E. C. Cotes in the "Indian Museum Notes":¹

¹E. C. Cotes, Further Notes on Insect Pests, Indian Museum Notes, Calcutta, vol. I, 1889-1891, No. 11, The Mango Weevil (*Cryptorhynchus mangiferae*), pp. 45-46. Plate. (Taken from a paper by W. J. Simmons in the Journal of the Agricultural and Horticultural Society of India, Volume VIII, Part II, new series.)

The geographical range of the pest under consideration is extensive. It is found in the Isle of France and in Madagascar, and it would be interesting to learn something about its ravages, and to ascertain when it was first observed, how supposed to be introduced, etc., in the islands named. It does not yet affect all the mango-producing districts of India, but its march is progressive. Restricted apparently at one time to Dacca and the Southeastern districts, Backergunge, Furrirdpore, etc., I learn it is working its way westward and northward, and throughout Bengal and the neighboring districts. An article on the subject will be found at page 558 of *Reis and Rayyet* for 1885, in which we are told that this insect-pest has invaded the Presidency, and that in the season of 1885 it showed itself in the well kept orchard of Kaly Kissen Tagore. I learn from a gentleman residing in Ballygunge that every tree in his garden is infected. *Reis and Rayyet* also informs us that Slyhet was formerly practically free from this circulio, two or three mangoes per 1,000 alone being tainted. During the last few years the pest has gained ground so rapidly in Sylhet that now not a single tree nor fruit is free.

ITS INTRODUCTION

The mango weevil is not recorded by Dr. R. C. L. Perkins in that part of *Fauna Hawaiiensis*, published in 1900, dealing with the family of beetles to which this species belongs. As the collection of the species therein recorded by Dr. Perkins ceased some two years previous to the above date, it is almost certain that the weevil of the mango has been introduced since 1898. It came from India, or possibly the Philippines, if it occurs in the latter country, since mangoes have been shipped to Hawaii from both places. The beetle was introduced either during the developmental period in the seeds or in the hibernated state in the soil about plants from the infested countries, or possibly even in packing or crevices of boxes containing plants.

ITS OCCURRENCE IN HAWAII

The mango weevil is first recorded from the Hawaiian Islands by the writer in August, 1905.¹ The first specimen observed was

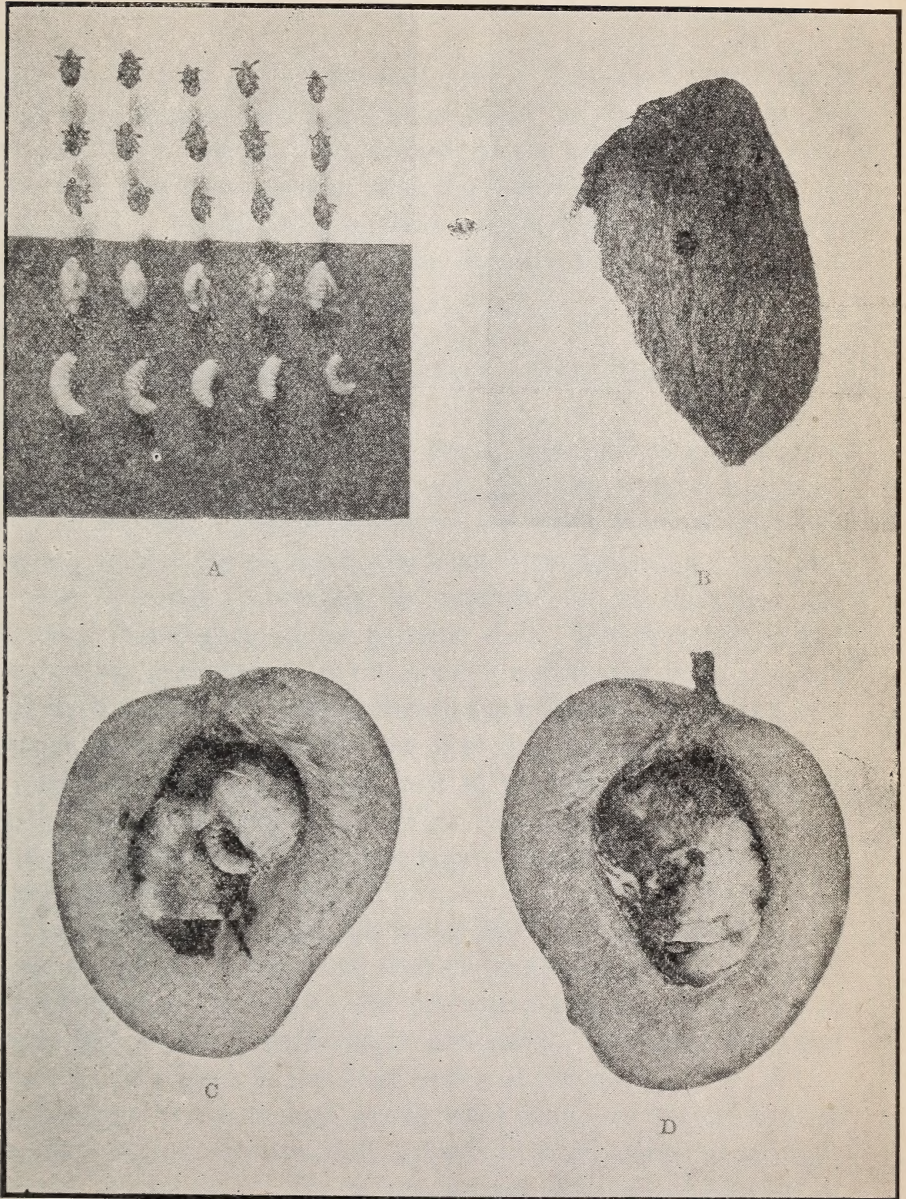
¹Pacific Commercial Advertiser, Honolulu, August 11, 1905, p. 3, and The Hawaiian Forester and Agriculturist, Vol. II, No. 8, (August), Honolulu, 1905, pp. 231-233.

a pupa that Mr. J. E. Higgins discovered July 5, 1905, within the seed of a mango that he had collected at Mr. Allan Herbert's former place at Kalihi, Island of Oahu. Two days later the writer visited the district of Moanalua, this Island, and there found larvae, pupae and adults within the seeds of various varieties of mangoes. Mr. Donald MacIntyre, Superintendent of Moanalua Gardens, had not noticed the presence of the weevil in the seeds for the reason that for the past two years he had not removed the husks from the seeds before planting them. For seven years previously, however, Mr. MacIntyre informed the writer that he had practiced the removal of all husks before planting seeds in the nursery and it is reasonable to suppose from this that the weevil made its advent into the Moanalua Gardens not earlier than 1903. Inquiry of Mr. David Haughs, Mr. J. E. Higgins and Mr. G. P. Wilder, all prominently interested in mango culture, brought out the information that the weevil had not been observed in Honolulu up to the summer of 1905. Mr. Haughs, in his connection with the Territorial Government Nursery, has planted mango seeds for many years and has practiced removing the husks from the seeds for horticultural reasons. The distribution last year, then, so far as is known, was confined to this Island (Oahu) and extended from Kalihi to Moanalua.

In July, 1906, Mr. Alexander Crow in a report as Superintendent of Entomology to the Territorial Board of Commissioners of Agriculture and Forestry, recorded the mango weevil as having been found this season from Palama, Honolulu, to Pearl City.¹

Mr. Otto Swezey informed the writer that he found specimens of the larvae, pupae and adults within the seeds of ripe fallen mangoes on Gulick avenue, Honolulu, on June 12th, 1906, and Dr. R. C. L. Perkins likewise states that he had found mangoes infested with the beetle this season at his home in Nuuanu Valley. The beetle is seen to have extended its distribution over a

¹Hawaiian Forester and Agriculturist, Vol. III, No. 7, (July), Honolulu, 1906, pp. 198-199.



THE MANGO WEEVIL (*Cryptorhynchus mangiferae*) AND ITS INJURY.

Explanation of Plate: A, Larvae, pupae and adults of the weevil, slightly reduced. B, a seed showing exit of adult weevil after completing development within. C, half a mango with fully developed larva within newly prepared pupal cell. D, half of mango showing destruction to seed. (Photographs by the author.)

considerable area during the past year. It is known that mangoes were shipped to the Island of Maui last year from the infested district (before the presence of the weevil had been discovered), and it is probable that the weevil has been carried to that island. To date the reported distribution is confined to the Island of Oahu and extends from Nuuanu Valley, Honolulu, in the Ewa direction to Pearl City.

THE WEEVIL AND ITS LIFE-CYCLE (See Plate I, A.)

As a beetle, the mango weevil has a thick pair of wing-covers which, when folded together at rest, give the body the appearance of a shell. The wing-covers are much rounded and extremely hard. As a weevil, the head is prolonged in front into a beak or rostrum, bearing the antennae on its sides and the modified mouth-parts at the extreme end. The mouth-parts are formed for gnawing. In the mango weevil, the beak is short and thick and when at rest is turned back beneath the thorax in a groove terminating between the first pair of legs. The adult weevil varied from $1/4$ of an inch to $5/16$ of an inch in length in the specimens measured. When newly developed, the adult is a whitish pink in color, but soon changes to a dark brown with yellowish markings.

The beetle feigns death on being disturbed and drops to the ground with the head drawn well under the thorax and the legs folded beneath the body. Its protective resemblance to coarse earth and debris is particularly noticeable. Nothing has been observed in regard to the food habits of the adult.

The eggs of the mango weevil were found on mangoes from one-half to three-fourths fully grown, situated alongside a slight incision on the rind. The writer has not observed egg-laying or carefully noted the habits of the weevil as regards oviposition, but is inclined to think that the eggs in the instances seen were probably placed within the incision or cavity and later forced out by the exudation of juice, an amount of which in a dried condition enveloped them.

The larvae in appearance are, generally speaking, like the sugar-

cane borer (the larva of *Sphenophorus obscurus*), that is, footless, "fleshy" grubs, light in color, with a dark head. The entire development after hatching from the egg is undergone within the seed. When fully developed, the larva constructs a pupal cell, surrounded simply by the excrement, within the tunnel formed by feeding, and transforms to the pupa. The inactive pupa is perfectly white in color with the developing head, legs, wings and body-parts plainly indicated.

The length of the various stages in the life-cycle of the mango weevil can be given only approximately from this year's notes. In the locality under observation, the adults became active about May 16th. The first newly hatched larvae were to be seen from May 28th on. Pupae were found on June 27th and adults on July 3rd. The first adult weevils seen of this year's brood were those reported by Mr. Swezey, taken by him June 12th on Gulick avenue, Honolulu. The mango crop in that locality, however, was nearly a month earlier than at the place where the above notes were taken. The life-cycle appears to be approximately 40 days in length and there can be but one brood a year.

ITS HIBERNATION

The various stages of the mango weevil were found last season all through July, following the discovery of the insect. Not more than one specimen was found in any one seed. During August, refuse seeds and the seeds of fallen mangoes contained some pupae and many adults. As late as September 11th the seeds beneath trees in the infested district contained adults but in no great numbers. It appeared that the beetles remained in the seeds for a time after completing their full development. On the last date mentioned, September 11th, three living adults were removed from as many seeds and placed in a tightly corked phial beneath a plug of cotton. On October 13th all of these specimens were living. The writer was absent from the Territory for nearly a month, but upon his return, November 15th, one weevil had died. Another weevil failed to show signs of life on January 3rd. The third specimen lived until February 10th. From



Fig. 1.—A fence beneath mango trees that contained numbers of hibernated weevils in cracks, crevices and behind the boards where nailed to the posts. Hundreds were found in one board that had been previously riddled by termites, the tunnels of the latter affording an excellent place of concealment. (Photograph by the author.)



Fig. 2.—A stone wall beneath mango trees in which hibernated weevils were found in large numbers. (Photograph by the author.)

PLACES IN WHICH HIBERNATED WEEVILS ARE FOUND.

these observations it was evident that the insect could pass a considerable period in an inactive state. The same date the above experiments were begun, a quantity of seeds from fallen mangoes from the infested district was placed in a breeding cage. The idea was to determine the length of time the adults would continue to appear from within the seeds. After making an exit through the husks the beetles showed no tendency to remain within the seeds. Apparently nearly all the weevils had left; however, on October 4th, four specimens were found on the wire screen above the seeds. One specimen appeared on October 15th and on November 16th the seeds were all taken out and examined and two dead specimens were found out of the seeds on the floor of the breeding cage, having issued from the seeds between October 15th and the last date mentioned during the absence of the writer. No weevils were contained in the remaining seeds.

At this time a visit was made to the infested district and all traces of the weevil had disappeared. Diligent search failed to show where they were until January 30th when the writer found them by the hundreds in the crevices of an old board fence and stone wall beneath a group of neglected mango trees in a deserted kuleana in Moanalua Valley. (See Plate II.) The writer believes that the larger portion of the weevils went into hibernating quarters in similar places during the latter part of August and the first part of September. The weevils were found in a state of hibernation in that particular locality up to May 16th. An active beetle was observed on the foliage of a nearby mango tree on that date. At this time the fruit crop was about one-half grown.

ITS ENTRANCE TO THE SEED

From May 16th on, hundreds of mangoes were sectioned in halves to find, if possible, evidences of the larvae within the seeds. May 28th one newly developed larva was found within the seed of a nearly full-grown mango. In several instances thereafter newly hatched larvae were found within the seed and

a faint, irregular discolored line or track leading from the tiny burrow within the seeds through the husk and into the flesh, indicated the mode of entrance. It is to be seen from this that the fruit is infested rather late in its development. The larva, apparently, on hatching from the egg on the rind or in the flesh, burrows at once to the seed within the husk and the resulting injury to the tissues of the fruit is so slight that soon all evidences of the means of entrance become effaced.

ITS INJURY (See Plate I, B, C, and D.)

The mango weevil is not known to attack any other fruit. Its injury to the mango is primarily the destruction of the seed. The incisions in the rind do, of course, blemish the fruit and offer places of infection for the germs of decay. In the first lot of mangoes examined on July 7, 1905, it was estimated that about 60 per cent. were infested, that is, out of 44 seeds examined, 28 contained either the larval, pupal, or adult, weevil. The inspection of another lot of seeds six days later resulted as follows, 16 seeds each of the "Number 9," the Chutney and the so-called "Hawaiian" variety being taken: Of the Number 9, 5 were infested; of the Chutney, 10 were infested; and of the Hawaiian, 8 were infested.

The following results were obtained from seeds planted in seed-beds: Twelve seeds each of the Chutney and "Number 1" were selected at random, and of the former, 10 were infested. Of the latter, 3 were infested. All of the infested seeds had failed to germinate. In both instances the Chutney variety showed the largest number of infested seeds.

The injury is much greater this season than last. The writer estimates that fully 80 to 90 per cent. of the mangoes are infested this year in what was considered the infested district last year. Where the weevil occurs for the first time this season, the infection is not so great. Not more than a single specimen was

observed within a seed last year. As many as four larvae have been found within a single seed this season and two and three specimens within a seed are common. Where as many as three or four larvae occur within one seed, the resulting decay from the excrement and seed extends through the husk, in some instances, to the flesh. Some growers are of the opinion that the work of the weevil hastens the maturity of the infected fruit and increases the percent. of fallen mangoes.

ITS NATURAL ENEMIES

No parasitic or predaceous enemies of the mango weevil have been observed. The writer believes, however, that many of the hibernated weevils are destroyed by lizards and centipedes.

ITS CONTROL

Natural Control: Since the mango weevil is a special feeder on the seed of the mango, its numbers in any particular season are in direct proportion to the size of the mango crop for that season. That is, when the mangoes are abundant, the brood of weevils arising from the fruit will also be large in numbers. Any natural condition of climate or disease that affects the mango crop will likewise reduce the numbers of the mango weevil.

Direct Measures: The fact that the weevil during its entire development is within the seed renders the use of any insecticide impossible in combating the pest. Since also there is practically no exterior evidence that the fruit is infested, little can be done in the destruction of infested fruit during the growth of the crop.

The destruction of all fallen mangoes and refuse seeds will be quite effective for the reason that the adult beetle does not leave the seed until some time after the maturity of the fruit.

The burning of all refuse about the mango trees during the

months from October to March would destroy many of the hibernated weevils.

To deprive the mango weevil of its food in any particular locality for two seasons would mean its extermination in that locality, and could re-invasion be prevented, it would further mean freedom from injury to future crops. An act worthy of the attempt would be to destroy for a period of two years all the fruit in the infested district after first making a careful survey of the distribution of the weevil. Neglected trees in deserted places and along the wayside could be cut down. All the common varieties could be cut back for in-arching or grafting with the finer varieties. The finer varieties, of which not a great number are under bearing, could be allowed to fruit and the fruit or refuse seeds destroyed. Certain trees should be left to fruit throughout the infested district to act as "bait" for the weevils. These trees should be under the control of inspectors and the fruit gathered and destroyed after the weevils of the previous season's brood had completed copulation and oviposition.

The limited time of the writer has been devoted almost entirely to the life-cycle and habits of the pest, necessary information on which to base methods of control, and concerning which practically nothing could be found. Another season's observation will be necessary to advance more definite advice on the control of this insect enemy of the mango.

Honolulu, H. T., August 14, 1906.

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